

SERVICE MANUAL



TECHNOLOGIES INC

MODEL H-500
FLUID WARMER

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[Revised June, 1989]

1.0 PURPOSE

The Level 1 Fluid Warmer system is designed for safe and rapid warming of I.V. and Irrigating fluids as they are administered to patients. Disposable sets specifically designed for I.V. Infusion and Normothermic Irrigating are available.

With an 8 1/2 French Catheter, the I.V. Sets allow infusion of 10°C blood at up to 700 ml/min or crystalloid to 1300 ml/min. Minimum delivery temperature at these flow rates is 34°C. At somewhat lower flow rates generally used, fluids are delivered near 37°C. Blood and packed RBC's from all autotransfusion systems may be infused through the Level 1 I.V. Sets, and will be delivered near 37°C.

Level 1 Normothermic Irrigating Sets warm room temperature irrigating fluids to a minimum delivery temperature of 36°C at flow rates to 760 ml/min.

High warming and flow capacity, simple operation, and on-board safety and monitoring systems make the Level 1 the ideal choice for procedures requiring infusing or irrigating with normothermic fluids.

Typical I.V. uses of the system include Trauma, Emergency and Major Surgery such as Major Vascular, GI Bleeders, Cancer Surgery, Lower Abdominal, Neuro Surgery, Major Orthopedic, and Open-Heart post-pump fluid replacement to maintain core temperature.

Typical Irrigating applications include T.U.R.(P)'s, Pediatric and Adult Cysto's, Orthopedic Surgery (joints), Peritoneal Lavage, Arthroscopic Surgery, and Major Surgery.

1.1 SYSTEM CONCEPT

The Level 1 Fluid Warmer makes available to all other areas in the hospital the same fluid warming technology Perfusionists have safely used in the Open-Heart Suite for on-pump warming for over 25 years.

The Level 1 System employs a Disposable Heat Exchanger. As with those used for on-pump warming, warmed water is rapidly circulated counter-flow through an anodized aluminum tube. The use of a thermal conductor (aluminum), rapid water circulation, and counter-flow warming all contribute to the excellent high warming capacity of the Level 1 System.

Taking advantage of the high warming capacity, the Level 1 Disposable Sets allow increased fluid flow rates, even with very cold blood. All of the Disposable Sets use large bore tubing and connectors.

The Hardware and Disposables of the Level 1 System are integrally designed to be highly effective and easy to use. By following the 1-2-3 instructions found on the H-500 Fluid Warmer, properly trained users can confidently and safely set-up and use the system.

1.2 SAFETY

AIR ELIMINATOR

The Level 1 Disposable Sets employ an unique Air Eliminator which vents micro-bubbles of gas always released from fluids as they are warmed. In many warming systems, these micro-bubbles are actually delivered to the patient along with the warmed fluids.

As with any fluid administration set, unwanted air may inadvertently enter the fluid path. The Level 1 Air Eliminator is also an important safety feature, capable of venting up to 400 ml/min of air from the system.

The ability of the Air Eliminator to quickly vent air also permits rapid priming of the Disposable Set.

The Air Eliminator in the I.V.Sets contains a screen filter to trap macro-aggregates. This filter is connected with inter-locks and is easily changed without patient disconnection or repriming of the entire disposable set. Replacement filters are available as follows:

For D-100 Set order replacement filter F-10
For D-300 Set order replacement filter F-30

TEMPERATURE CONTROL

The H-500 employs a circulating water heating system, inherently free of "hot spots". The primary temperature control circuit limits the circulating water to a 40 °C maximum. In the unlikely event of a malfunction of this circuit, a second "watchdog" circuit will visually and audibly alarm and stop the circulating water pump if the temperature reaches about 41 °C. This prevents damage to blood proteins which may begin as low as 41.5 °C and red cells which are damaged by even higher temperatures.

Fluid present in the heat exchanger while the unit is operating is thus never exposed to any damaging or dangerous temperatures.

ELECTRICAL SAFETY

A special low leakage immersion heater is used in the Level 1 H-500. This heater is electrically grounded through the power cord providing an extra measure of patient and operator safety.

4.0 ELECTRICAL SAFETY

4.1 POWER REQUIREMENT

The H-500 draws a maximum of 11.5 Amps. It should be plugged into a 15 or 20 Amp circuit, being sure there are no other major power consumers on that circuit.

Most of the current drawn by the H-500 is for its 1000 Watt immersion heater.

When the device is first turned on and the digital display shows rapidly rising temperatures below 30°C, the 1000 Watt heater is in a full ON condition. Beyond approximately 30°C, the proportional controller cycles the heater ON/OFF with proportionally shorter ON times as the circulating water nears the 40°C target temperature.

A normal slight rise and fall of the water pump motor hum may be heard as the immersion heater is cycled by its control system.

4.2 LEAKAGE CURRENT TEST

NOTE: This device is equipped with disposable sensing interlocks. A Level 1 Disposable Set is required to operate the device and perform leakage current testing. Non-Sterile Test Sets are available from Level 1 for this purpose. See the Parts List in this manual.

WARNING: DO NOT DEFEAT THE DISPOSABLE SENSING INTERLOCKS OR TRY TO OPERATE THE UNIT WITHOUT A DISPOSABLE HEAT EXCHANGER IN PLACE.

Power On Leakage Current Tests should be performed with the immersion heater circuit in the full ON condition. In order to be sure the immersion heater circuit is in a full ON condition, Power On Leakage Current Tests should be performed on units which have been allowed to stand until close to room temperature. As the H-500 warms up quickly, test readings should be taken within 1 minute of startup.

Although the specifications claim less than 100 microamps electrical leakage, units leaving the factory are usually less than 50 microamps.

Units exceeding 100 microamps electrical leakage should be removed from service and returned to Level 1 for repair.

2.1 UNPACKING

The Level 1 Fluid Warmer is packaged partially assembled in two separate boxes.

	Contents	Qty
LONG BOX	Pole Assembly.	1
LARGE SQUARE BOX	Service Manual	1
	Operator's Manual	1
	Power Module	1
	Rolling Base	1
	Casters	4
	I.V. Bag hanger	1
	I.V. Pole Knob	1
	Funnel	1

2.2 SET-UP

===== WARNING ======
 This H-500 must be assembled and tested by Level 1 Technical Personnel or an authorized distributor of Level 1 prior to placing the device into service.

- 1 With the Rolling Base/ Power Module on its side, push the 4 casters FULLY into their sockets. Place the unit upright on its wheels.
- 2 Remove the PIN from the vertical square base tube.
- 3 Slide the Pole Assembly down over the vertical square base tube with the 2 flexible Water Tubes facing the black tube fittings as shown in Figure 1.

Note: In the next step it may be helpful to have someone raise the Pole Assembly slightly and lower it into position as the Water Tubes are slid into their fittings.

- 4 To connect the 2 Water Tubes:
 [Short tube to upper fitting]
 [Long tube to lower fitting]
 A Remove the protective end caps.
 B Press each Water Tube straight into its fitting until it bottoms on the internal stop. [1/2"] Be sure they are fully seated in their fittings and can not be pulled out. If your hands are not strong, have someone else push in the tubes or check them.
- 5 Insert the PIN through the holes in the Pole Assembly and vertical base tube, locking them together.
- 6 Connect the Pole Interlock connector.

3.0 FILLING WITH DISTILLED WATER

FIGURES 2 & 3

===== IMPORTANT =====

For proper system operation and component life, only DISTILLED WATER should be used in the water reservoir. The use of tap water in the unit will build up mineral scale and seriously reduce its operating efficiency.

DO NOT FILL the unit with a DISPOSABLE SET IN PLACE as this creates an air lock preventing proper filling.

A Check that the Water Drain Plug is tight with a large coin (quarter) or large screwdriver.

B Depress the Red Ring to remove the Fillport Plug while pulling the plug UP and OUT of the fitting.

C Place the funnel supplied with the unit in the fillport.

D Fill with 2 Liters of Distilled Water.

Notes: 1 If this is the first time the device is being filled, an extra 200 ml is required.

2 A water reservoir vent port exits the bottom of the Power Module at the location shown in Figure 3. This vent port also serves as an overflow tube. An easy way to be sure the water reservoir is full is to place a cup under this vent port and fill the reservoir until water begins to exit the port.

E Remove the funnel and replace the Fill Port Plug by pushing it straight down into its fitting until it bottoms.

===== IMPORTANT =====

The Distilled Water in the reservoir should be changed every 30 days. See the Maintenance Section of this manual.

5.0 ALARM TESTING

NOTE: Alarm testing requires a Level 1 Disposable Set to be in place on the H-500.

Non Sterile Test Sets are available from Level 1 for this purpose.

See the Parts List in this manual.

ADD WATER ALARM

The H-500 is equipped with a float switch which senses the water level in the on-board reservoir.

When the water level is too low, a RED L.E.D. on the Display illuminates and a sonic alarm sounds.

In the alarm condition the circulating pump should not be running, but the fan will continue to run.

There are two ways to test the ADD WATER ALARM circuit.

- 1 With a Test Disposable Set in place, the ADD WATER ALARM may be tested by removing the Water Drain plug on the side of the Power Module allowing some of the water to drain out.

CAUTION: Locate the Water Drain port over a floor drain or large container.

Replace any water drained with DISTILLED WATER.

- 2 The second method allows quick confirmation the circuit is working without draining water.

Roll the entire H-500 from side to side on its wheels to set up a wave motion in the on-board reservoir. This should cycle the ADD WATER ALARM several times before returning to normal operation. If the alarm will not stop pulsing after this test, shut the unit off and add about 200 ml of distilled water to the Fill Port. Re-start the unit and confirm normal operation.

See section 3.0 Filling With Distilled Water.

CHECK DISPOSABLES ALARM

Three interlocks sense properly installed Disposable Sets. If a properly installed Disposable Set is not in place and the Power Switch is ON, the RED indicator will illuminate and a pulsed alarm will sound. With the unit running, each interlock may be independently tested:

- 1 Top Heat Exchanger Socket - Pull Release knob and slide UP.
- 2 Heat Exchanger Guide - Bend white tube portion of Heat Exchanger out of Guide groove.
- 3 Air Eliminator - Remove from holder.

OVER TEMPERATURE ALARM

With a Test Disposable Set in place and the Power Switch OFF, drain the water out of the reservoir by removing the Water Drain plug located on the side of the Power Module.

CAUTION: Locate the Water Drain port over a floor drain or large container.

Fill with 2 liters of DISTILLED WATER which has been heated to 45 to 48°C. (see Section 3.0)

Turn the Power Switch ON.

The Overtemperature RED L.E.D. on the Display Panel should illuminate and the Sonic Alarm should sound. The water circulating pump should not be running, although the fan will continue to run.

Confirming the above, turn the Power Switch OFF and allow the unit to cool to room temperature. Restart the unit and confirm normal operation.

6.0 PERFORMANCE TESTING

NOTE: Performance testing requires a Level 1 D-100 Disposable Set to be in place on the H-500. Non-sterile Disposable Test Sets are available from Level 1 for this purpose. See the Parts List in this manual.

THREE simple tests allow periodic checking of the overall operating efficiency of the H-500.

1 COLD START TEST

Store the H-500 unit in a room where the room temperature is approximately 21°C [70°F].

With a D-100 Set in place, note the time and turn the Power Switch ON. The Green System Operational indicator will illuminate.

Rapidly rising numbers will appear on the Water Temperature display. 37°C will appear in about 3 minutes on an efficiently operating unit.

2 SYSTEM RECOVERY TEST

Chill a 1 liter bag of Normal Saline to 10 to 15°C.

With a D-100 Test Set in place, turn the Power Switch ON and allow the H-500 to reach at least 39.5°C.

Remove the cap from the Male Luer at the end of the Patient Line and place the Male Luer in a container on the floor.

Close the Priming Chamber clamps, and spike the fluid bag.

Raise the I.V. Pole as high as possible without kinking the tubing of the Disposable Set. Note the time and OPEN the clamp below the bag, allowing the fluid to flow freely.

Watch the Water Temperature display. The fluid bag should empty in less than 2 minutes and 30 seconds, and the digital display of an efficiently operating unit will not read below 37.5°C.

3 STEADY STATE RUN TEST

This test should be performed in a room temperature between 18°C [65°F] and 24°C [75°F].

With a D-100 Test Set in place, turn the Power Switch ON. Record the time. After 30 minutes of continuous running, observe the Water Temperature display. An efficiently operating unit should display 39.6 to 40.2°C. Accuracy of the digital water temperature display may be checked by turning the unit off and immediately draining some water from the Power Module into a foam plastic cup and checking with a calibrated immersion thermomet

NOTE: IF THE H-500 DOES NOT MEET 1,2,or 3 IT SHOULD BE RETURNED TO THE FACTORY FOR SERVICE.

7.0 MAINTENANCE

7.1 CLEAN EXTERIOR	EVERY USE
Clean the entire H-500 with a spray of warm soapy water solution or a commercial non-abrasive cleaner and a soft cloth after every use. Cold sterilizing solutions may be used, but strong chemical concentrations may discolor some of the plastics on the device. Do not use cleaning agents containing abrasives.	
7.2 CHANGE DISTILLED WATER	EVERY 30 DAYS
Locate the Water Drain over a floor drain. Remove the plug with a coin or large screwdriver. Reinstall the plug using new Teflon Tape if required. Refill with 2 liters of distilled water. See Section 3.0	
7.3 GREASE O-RING SEALS	EVERY 30 DAYS
Place a small amount of silicone grease on a cotton swab or the end of a small finger and apply all around the O-rings in the bottom and top heat exchanger sockets of the Pole Assembly. It is not necessary to disassemble the sockets to grease them.	
7.4 CLEAN AIR FILTERS	EVERY 4 MONTHS
Snap off both filter retainers located on the bottom of the Power Module. Remove the foam elements and wash in warm soapy water. Rinse and dry the elements, and replace them in their retainers. Snap the retainers back in place on the bottom of the Power Module, noting the position of the snap-tabs and respective undercuts.	
7.5 CHANGE O-RING SEALS	EVERY 12 MONTHS
Note: An O-ring Kit containing 2 O-rings, a 1/8" hex wrench and silicone grease is available from Level 1. See the Parts List in this manual. Using a 1/8" hex wrench, unscrew the four stainless button head screws of each socket and remove the rectangular Socket Caps. After removing and discarding the old O-rings, clean the O-ring sockets. Coat the new O-rings with silicone grease and press them into their sockets. Replace the Socket Caps and button head screws.	
7.6 GENERAL INSPECTION	EVERY USE
Visually check the condition of the device. Remove any unit from service which shows physical damage or one in which the Test Disposable Set does not install easily.	

8.0 SERVICE

ALL SERVICE MUST BE PERFORMED BY LEVEL 1 TECHNOLOGIES OR ITS AUTHORIZED AGENTS. SERVICE BY OTHERS VOIDS THE WARRANTY AND TRANSFERS LIABILITY FOR MALFUNCTIONS OF THE DEVICE TO THE SERVICING ORGANIZATION.

FOR SERVICE, CONTACT: LEVEL 1 TECHNOLOGIES 617-834-0023
 800-553-8351
(or your local distributor)

The Level 1 H-500 is designed for easy disassembly so the Power Module, Pole Assembly or Rolling Base may be removed and sent to the factory for service. Generally, module removal is the reverse of the assembly steps found in Section 2.0 Drain the water from the Power Module Water Drain before disassembly. Be sure ALL water is drained before packing any module for repair shipment.

The Power Module is secured to the Rolling Base by four hex head bolts. Remove these to separate the Power Module from the Rolling Base.

For service ship prepaid to : LEVEL 1 TECHNOLOGIES INC.
 83 ENTERPRISE DRIVE
 MARSHFIELD, MA 02050

 Attn: SERVICE DEPARTMENT

- Include the following :
 - Hospital Name
 - Address
 - Telephone Number
 - Person to Contact
 - Apparent Problem

WARRANTY SERVICE

Modules received for repair which have not been obviously abused or impact damaged and still under Warranty will be promptly repaired and returned at no charge. See the Limited Warranty Section 12.0 of this manual.

NON-WARRANTY SERVICE

Modules received which have suffered obvious abuse or impact damage and modules no longer under Warranty will be promptly inspected and a written estimate of repair costs will be sent to you. A purchase order will be required from the hospital consistent with the written estimate.

1.0 SPECIFICATIONS

9.1 PHYSICAL SPECIFICATIONS	DOMESTIC	INTERNATIONAL
Height, assembled	5' 2" plus IV Pole	1,58 m + IV Pole
Height, IV Pole	5' 2" - 7' 8"	1,58 m - 2,34 m
Length, overall	19"	48,3 cm
Width, overall	18.2"	46,3 cm
Weight, assembled, dry	56 pounds	25,4 kg
Shipping weights:		
Pole Assembly	8 pounds	3,6 kg
Power Module	28 pounds	12,7 kg
Rolling Base	20 pounds	9,1 kg

9.2 ELECTRICAL SPECIFICATIONS

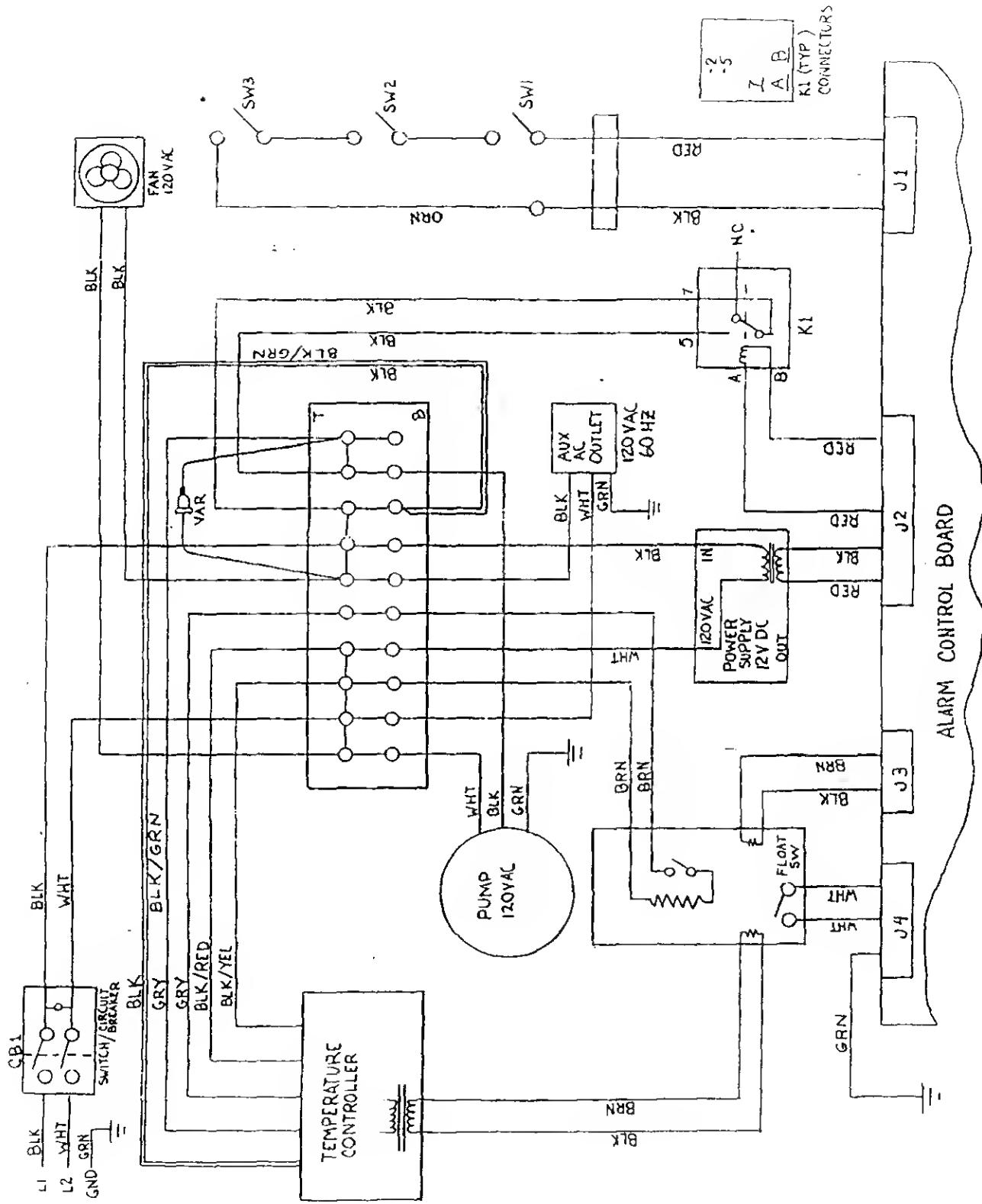
Input Voltage	110-130 VAC	220-240 V
Operating Frequency	50-60 Hz	50-60 Hz
Operating Current	12.0 Amp.	6.0 A
Circuit Breaker	15.0 Amp.	6.0 A
Power Cord	14/3 SJT x 12'	16/3 <HAR> x 3,65 m
Plug	Hospital Grade	

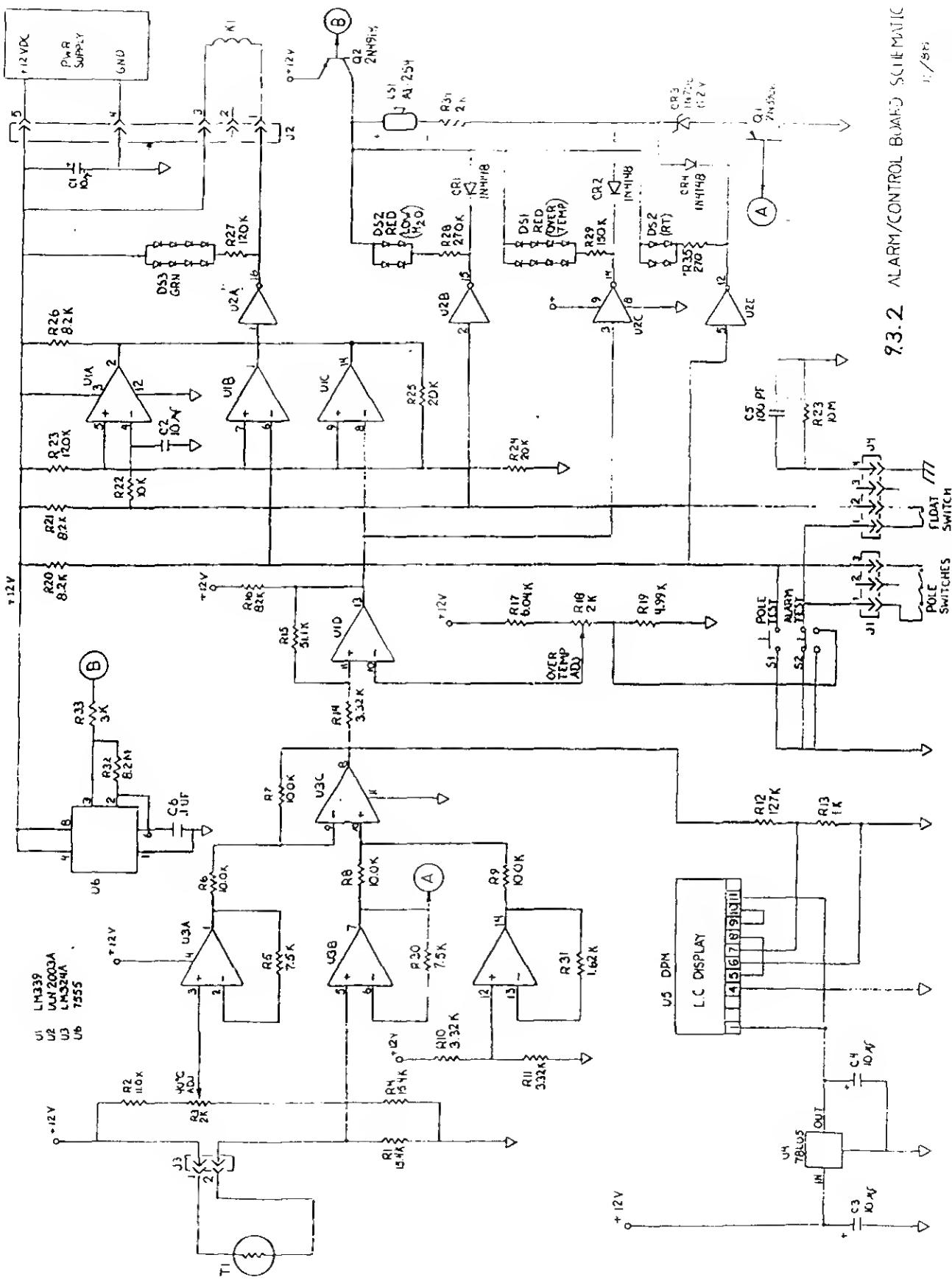
9.3 ELECTRICAL SCHEMATICS

The Electrical Schematics in this manual are for information only. They are NOT intended for user service. Any service performed on this unit, not authorized by Level 1, will void the warranty (if in effect) and TRANSFER LIABILITY for any malfunction TO THE SERVICING ORGANIZATION.

CAUTION: Precision thermometry equipment accurate to 1/10 of 1 C and traceable to the National Bureau of Standards is required for correct calibration of the Level 1 H-500 Fluid Warmer.

As this equipment is not normally found in a hospital biomedical engineering department, Level 1 considers the H-500 NOT USER SERVICEABLE for electrical circuit repairs or adjustments. Temperature adjustments are factory sealed and tamper evident.



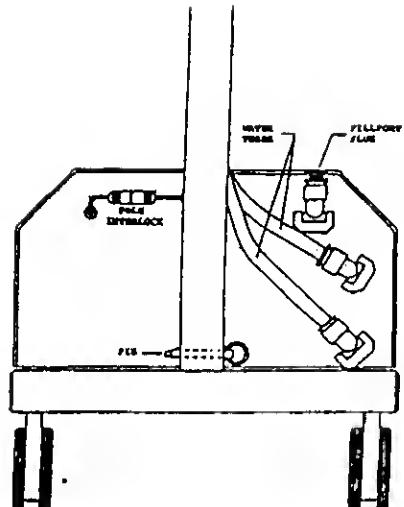


9.3.2 ALARM/CONTROL BUAFÜ SCIMATIC H 500

10.0 TROUBLESHOOTING

10.1 INOPERABLE SYSTEM,

H-500



PROBLEM	CHECK
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NO POWER

Unit PLUGGED IN ?
Power Switch ON ?
Minimum 15 AMP circuit ?

Note: If power is reaching the unit from the wall and the Power Switch is turned ON, the switch will GLOW, and the Fan should run.

NO GREEN SYSTEM OPERATIONAL LIGHT

and

CHECK DISPOSABLES ALARM

Disposable Set
properly installed ?

All 3 Pole Interlocks
properly engaged by the
Disposable Set ?

Pole Interlock Connector
between Pole Assembly and
Power Module connected ?

ADD WATER ALARM WHEN UNIT IS MOVED

Add about 200 ml's of
distilled water to the
reservoir through the
Fill Port. DEPRESS RED
RING TO REMOVE GREY PLUG.

ADD WATER ALARM WHEN UNIT IS TURNED ON

Fill with distilled water
until alarm stops. Refer
to Service Manual for
complete draining and
filling instructions.

OVER TEMPERATURE ALARM

Turn off the Power Switch
and remove the unit from
service. It must be repaired
or replaced by Level 1
Technologies, Inc.
Refer to Service Manual for
repair information.
Note: Room temperature over 40°C
(104°F) may cause the H-500 to
shut down and alarm. In this
unusual situation, turn the
Power Switch OFF and allow the
unit to cool before returning
it service.

LONG WARM UP

Unit stored in an unusually
cold environment ?

HOT POWER MODULE CABINET

Dirty air filters on bottom
of Power Module ?
Fan not Operating ?

HARD TO INSTALL HEAT EXCHANGER

Grease O-Rings in Heat Exchanger
Sockets with silicone grease.
Order Part No. Z-009

WATER LEAKS AT HEAT EXCHANGER SOCKETS

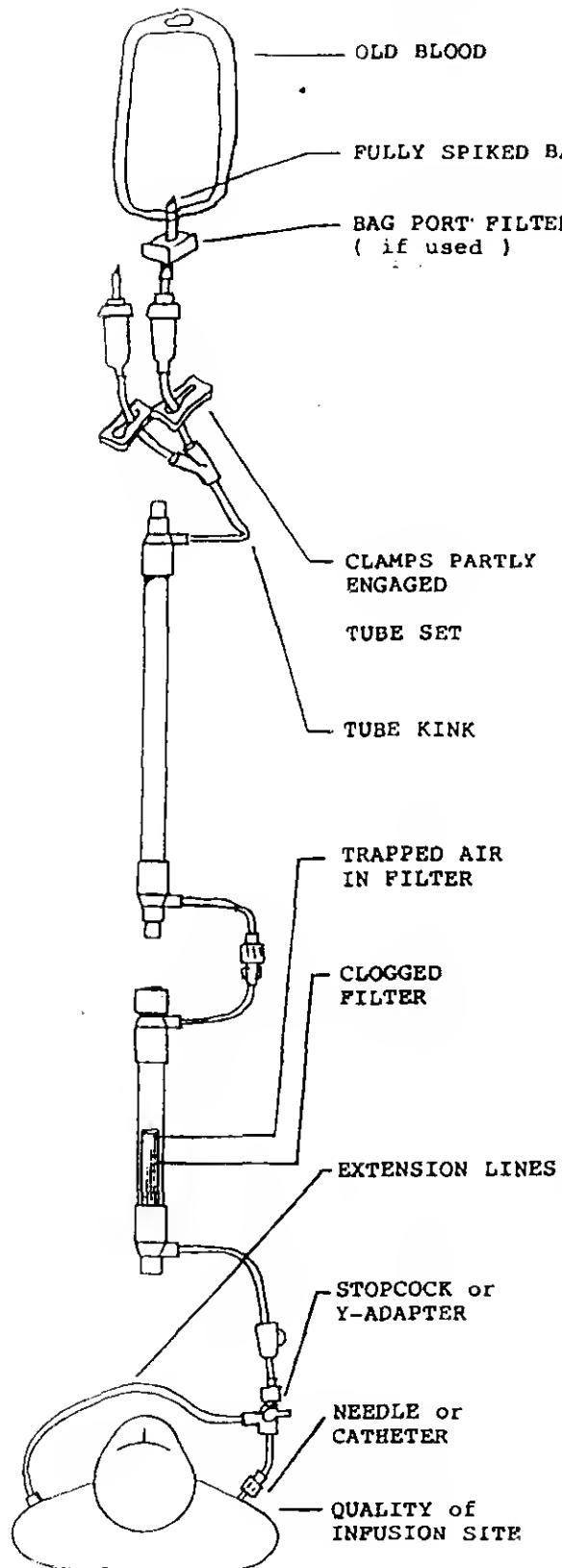
Replace O-Rings
See Service Manual
Order Part No. Z-008

10.2 FLOW RESTRICTION, I.V.DISPOSABLE SETS

FIGURE 10

Many factors which are insignificant in low flow fluid administration are restrictors of high flow infusion.

If you encounter low flows with the Level 1 System,
CHECK EACH OF THESE POSSIBLE CAUSES.



Stored blood begins to develop particulate within 5 to 7 days. This may partially block fluid pathways, impeding flow.

FULLY SPIKED BAG Bag port membranes may only be split, not completely pierced.

BAG PORT FILTER (if used) Small sized filters used between the blood bag and the large bore bag spike of the Level 1 set restrict flow because:

- 1 They are not physically large enough to pass the fluid volumes required for high flow infusion.
- 2 They trap air, reducing the already inadequate effective filter area.
- 3 Cold, viscous blood does not flow well through small pore filters.
- 4 As they are directly connected to the source of particulate with no pre-filtering, they clog quickly.

Check to be sure all clamps are FULLY open.

Leaving clamps engaged for extended periods of time when the Disposable Set is not in use (such as pre-set-up) will cause the tubing to take a SET in the clamped position.

Be sure no tube kinks are present anywhere in the set, especially in the Y-set when a pressure cuff is employed and the I.V.Pole is used in a lowered position.

As noted in the Priming Instructions, remove the Filter from the holder and tap against the Pole Assembly to dislodge air bubbles and allow them to vent out.

If good quality blood is used, this filter should never cause flow restriction. In the event of a clogged filter, this component may be changed. See OPERATOR'S MANUAL Section 5.0 If frequent clogging is encountered, discuss the QUALITY of the blood being used with your Blood Bank.

Use only extension lines with a bore of .130" or {3.3mm} or larger, equipped with large bore fittings, such as Level 1 Part No.'s X-36 or Y-30.

Any fittings attached to the male luer-lock at the end of the Patient Line should have large bores. If their bores are smaller than the male luer-lock, they are restrictors.

When possible, use a minimum 14 Gauge needle or 8 1/2 French catheter. Smaller sizes will reduce flow.

Poorly placed needles and catheters, regardless of size, do not allow high infusion flow rates. LARGE BORE CATHETERS KINK EASILY, particularly when pulled to one side or taped into position.

FIGURE 4

11.0 PARTS LIST, MAINTENANCE AND USER REPLACEABLE PARTS

<u>DESCRIPTION</u>	<u>PART NUMBER</u>
Air Filter Element (2 pack)	Z - 001 -
Caster, dual wheel	Z - 002
Drain Plug, Power Module	Z - 003 -
Fill Port Plug	Z - 004 -
Funnel, 4 oz. polyethylene	Z - . 005
I.V.Pole, chrome, with bag hanger	Z - 006
I.V.Pole Knob, with threaded shaft	Z - 007
Manuals: Operator's Service	Z - OM Z - SM 0310000
Non-Sterile Test Set (not for patient use)	D - 100NS 32 0
O-ring Replacement Kit (for 2 Sockets, Top & Bottom)	Z - 008 - 15.00 0305000
Silicone Grease	Z - 009
Teflon Tape, roll	Z - 010
Hitch Pin (locks Pole to Base)	Z - 011
Cover Assembly, Power Module	Z - 012

Thermal Well
Tow-Ven Service
* 450.00
8031040
Todd C/P

12.0 LIMITED WARRANTY
LEVEL 1 FLUID WARMER
MODEL H-500

This Level 1 Fluid Warmer is warranted by Level 1 Technologies, Inc. to be free of material and workmanship defects for a period of 1 year (12 months) from the date of purchase, abuse and impact damage excluded. Level 1 reserves the right to replace any or all components in lieu of repair. During the period this warranty is in effect, any Level 1 H-500 Fluid Warmer found to be defective and shipped to Level 1, shipping costs prepaid, will be repaired or replaced. This warranty does not cover misuse, impact damage or obvious abuse of the device. No warranty or affirmation of fact, expressed or implied, other than stated above, is made or authorized by Level 1, and Level 1's liability in all events is limited to the purchase price paid for the device.

SERIAL NUMBER LABEL

Power Modules returned for Warranty service must have Serial Numbers intact. Those with missing or altered Serial Numbers will be serviced as Non-Warranty repairs.

PROMPT DISPOSITION

Level 1 will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within warranty. See the Service section of this manual for shipping information for product requiring service.

**HARDWARE
STANDARD OPERATING
PROCEDURES**

ENG: Mauri Kukko
QC: Jeanne Green
MFG: Norman Robitaille

FR ECO # 157

HSOP# 001

Description
H-500 FINAL

Revision
B

Date
07/25/95

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CALIBRATION PROCEDURE

File Name: HSOP001.DOC

1. SET UP

- 1.1 RECORD THE RESULTS OF THE FOLLOWING ON H.S.O.P. 001.5 IF THE UNIT UNDER TEST FAILS TO MEET THE FOLLOWING TEST PARAMETERS TAG THE MACHINE WITH A DESCRIPTION OF THE FAILURE AND NOTIFY YOUR SUPERVISOR.
- 1.2 FILL UNIT WITH TAP WATER.
- 1.3 INSTALL THE T-40 CALIBRATED THERMOMETER.
- 1.4 RECORD THE CALIBRATED THERMOMETER SERIAL #, YOUR NAME, AND THE DATE ON THE CALIBRATION WORKSHEET (H.S.O.P. 001.5). ALSO RECORD THE AMBIENT TEMPERATURE.

2. CHECK FOR LEAKS

- 2.1 TURN UNIT ON. OBSERVE ALL FITTINGS AND SEAMS IN THE CIRCULATING WATER SYSTEM FOR LEAKS.

3. CHECK POWER SUPPLY VOLTAGE

- 3.1 PLACE DC VOLTAGE METER LEADS ACROSS THE PCB CONNECTOR (J5), POSITIONS 4 AND 5. THE MEASUREMENT SHOULD READ 12 VOLTS \pm 0.1 VOLTS.
- 3.2 ADJUST POWER SUPPLY OUTPUT IF NECESSARY.

4. SET OVER TEMP. ALARM

- 4.1 WATER TEMPERATURE MUST BE AT LEAST 39.5°C FOR DOMESTIC AND 40.5°C FOR INTERNATIONAL TO PROCEED WITH TEST.
- 4.2 ADJUST THE 40 ADJ. POT SO THE LCD READS;
 - A) 41.5 \pm 0.0°C FOR DOMESTIC
 - B) 42.0 \pm 0.0°C FOR INTERNATIONAL
- 4.3 ADJUST THE OVERTEMPERATURE CLOCKWISE UNTIL THE ALARM SOUNDS.
- 4.4 ADJUST THE 40 ADJ. POT COUNTER CLOCKWISE AND CONFIRM THAT THE ALARM DEACTIVATES AT 40.2 \pm 0.2°C FOR DOMESTIC AND 40.7 \pm 0.2°C FOR INTERNATIONAL.
- 4.5 ADJUST THE 40 ADJ. POT CLOCKWISE AGAIN AND CONFIRM THAT THE ALARM ACTIVATES AT 41.5 \pm 0.0°C FOR DOMESTIC AND 42.0 \pm 0.0°C FOR INTERNATIONAL.
- 4.6 REPEAT STEPS TWO TIMES TO CONFIRM THE ACTIVATION AND DEACTIVATION POINTS.

5. SET CALIBRATION OF DISPLAY

- 5.1 COMPARE UNIT LCD TO T-40 CALIBRATED THERMOMETER DISPLAY.
- 5.2 TURN THE 40 ADJ. POT ON PCB SO THAT THE UNIT LCD IS EQUAL TO THE CALIBRATED THERMOMETER LCD \pm 0.0°C.

6. POLE INTERLOCK SWITCH TEST

- 6.1 CHECK TOP SOCKET WHILE LATCHED DOWN. GRASP FIRMLY AND MOVE IN ALL DIRECTIONS. UNIT SHOULD NOT ALARM. RELEASE LATCH AND SOCKET UPWARDS. ALARM SHOULD ACTIVATE. RETURN SOCKET TO LATCHED POSITION. UNIT SHOULD BE OPERATIONAL.
- 6.2 TO CHECK POLE INTERLOCK SPRING. HEAT EXCHANGER OUT OF INTERLOCK THE ALARM SHOULD ACTIVATE. RETURN HEAT EXCHANGER INTO INTERLOCK AND THE UNIT SHOULD BECOME OPERATIONAL. THE SAME PROCEDURE IS USED FOR THE FILTER INTERLOCK TEST.

**HARDWARE
STANDARD OPERATING
PROCEDURES**

ENG: J. Kuhn Kuhn
QC: J. Green
MFG: Norman Robert

TR ECO # 157

HSOP# 001

Description
H-500 FINAL
CALIBRATION PROCEDURE

Revision
B

Date
07/25/95

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File Name: HSOP001.DOC

7. ALARM TEST SWITCHES

7.1 TO CHECK POLE OVER-RIDE TEST SWITCH RELEASE FILTER FROM INTERLOCK. THE ALARM SHOULD SOUND AND IT'S RESPECTIVE LED SHOULD FLASH. DEPRESS S-1 ON PCB AND THE SYSTEM SHOULD RETURN TO ITS OPERATIONAL STATE. RELEASE S-1 AND THE ALARM WILL REACTIVATE UNTIL THE FILTER IS PLACED BACK INTO INTERLOCK.

7.2 DEPRESS ALARM TEST SWITCH AND THE GREEN LED SHOULD TURN OFF. ALL RED LED'S SHOULD BE FLASHING AND THE ALARM MUST BE AUDIBLE. RELEASE SWITCH AND THE SYSTEM SHOULD BECOME OPERATIONAL. (SWITCH = S-2)

8. CHECK FLOAT SWITCH

8.1 TO CHECK FLOAT SWITCH, TILT UNIT BACK UNTIL THE FLOAT SWITCH ALARM ACTIVATES. RETURN UNIT TO LEVEL GROUND TO RE-OPERATE.

9. SET UNIT AT 39.9 FOR DOM. AND 40.9 FOR INT.

9.1 TURN TEMP. CONTROLLER POT CW TO INCREASE TEMPERATURE.
9.2 A SMALL TURN OF THE POT IS A LARGE INCREASE IN TEMP.
9.3 ALLOW TIME TO STABILIZE TEMP. BETWEEN ADJUSTMENTS.
9.4 SET UNIT TO RUN AT $39.9^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ FOR DOMESTIC AND $40.9 \pm 0.1^{\circ}\text{C}$ FOR INTERNATIONAL.

COLD START

10.1 TURN UNIT OFF. REPLACE WARM WATER WITH COLD.
10.2 PLACE A CLAMP CURRENT METER AROUND ONE OF THE HEATER WIRES (LINE OR NEUTRAL).
SET METER ON 15 AMP RANGE.
10.3 TURN UNIT ON. THE HEATER CURRENT SHOULD CHANGE FROM A CONSTANT DRAW TO PULSE MODE BETWEEN $39.2 \pm 0.3^{\circ}\text{C}$ FOR DOMESTIC AND $40.2 \pm 0.3^{\circ}\text{C}$.

11. CHECK FLOW RATE

11.1 REMOVE CALIBRATED T-40 THERMOMETER AND REPLACE WITH FLOW RATE METER. THE FLOW RATE OF THE CIRCULATING WATER MUST BE BETWEEN 2.5 ± 0.2 GALLONS PER MINUTE.

12. IDLE CHECK

12.1 ALLOW UNIT TO RUN FOR 1 HOUR TO ENSURE $39.9^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ FOR DOMESTIC AND $40.9^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ FOR INTERNATIONAL.

13. SEND UNIT TO Q.A. FOR ELECTRICAL TESTING AND FINAL INSPECTION.